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APPLICATION NUMBER: *60/526,080*
FILING DATE: *December 02, 2003*

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COMMISSIONER OF PATENTS AND TRADEMARKS

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Certifying Officer

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PROVISIONAL APPLICATION FOR PATENT COVER SHEET

This is a request for filing a PROVISIONAL APPLICATION FOR PATENT under 37 CFR 1.53(c)

INVENTOR(S)		
Given Name (first and middle [if any])	Family Name or Surname	Residence (City and State or Foreign Country)
Anders	BRAHME	Danderyd, Sweden

☐ Additional inventors are being named on the _____ separately numbered sheets attached hereto

TITLE OF THE INVENTION (500 characters max)

EXCENTRIC TREATMENT UNIT FOR RADIATION THERAPY

CORRESPONDENCE ADDRESS

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ENCLOSED APPLICATION PARTS (check all that apply)

☒ Specification	*Number of Pages:* 16	☐ CD(s), Number	
☒ Drawings	*Number of Sheets:* 8	☒ Other (specify)	
☒ Application Data Sheet		Abstract	

METHOD OF PAYMENT OF FILING FEES FOR PROVISIONAL APPLICATION FOR PATENT

☐ Applicant(s) claims small entity status.

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The invention was made by an agency of the United States Government or under a contract with an agency of the United States Government.

☒ No

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Respectfully submitted,

Docket No.: **1503-1055**

By: Benoit Castel

Benoit Castel, Reg. No. 35,041

Date: **December 2, 2003**

BC/la

PROVISIONAL APPLICATION FILING ONLY

EXCENTRIC TREATMENT UNIT FOR RADIATION THERAPY

TECHNICAL FIELD

The present invention generally refers to radiation therapy devices, and in particular to such machines with an excentric gantry design.

BACKGROUND

During the past decades there have been considerable developments within the fields of radiation therapy and medical diagnosis. The performance of external beam radiation therapy accelerators, brachytherapy and other specialized radiation therapy equipment has improved rapidly. Developments taking place in the quality and adaptability of therapeutic radiation beams have included new targets and filters, improved accelerators, increased flexibility in beam-shaping through new applicators, collimator and scanning systems and beam compensation techniques. Also improved dosimetric and geometric treatment verification methods have been introduced. In addition, new treatment planing system capable of biologically optimize the intensity distribution of the delivered beam are being developed.

In the field of (multiple and single fraction) radiotherapy treatment and diagnostics imaging, a common general method is to arrange a patient on a couch. A radiation head is directing a diagnostic or therapeutic beam relative the patient in order to deliver radiation to a certain target or treatment volume, e.g. a tumor. Such a typical radiation machine according to the prior art is schematically illustrated in Fig. 1. The radiation machine comprises a gantry 1 designed in a general L shape, and a rotational support provided at one axial end of the body of the machine for supporting the gantry 1. Thus, the gantry 1 can rotate around a rotation axis 30 relative the support in order to deliver radiation doses, schematically illustrated by 10, from a radiation head 20 into a target volume 55 of a patient 50 positioned on a patient couch 40.

Almost all radiation therapy machines of today, including the machine in Fig. 1, comprise an isocentric gantry design. In such a design, the tissue or target volume 55 to be radiated is preferably positioned around a so-called isocenter typically formed by the intersection of three axes at a common point (the origin of isocenter). These axes include the gantry rotation axis 30, the central axis of the radiation beam 10, as well as the rotation axis of the collimator head 20.

A problem with such prior art radiation therapy machines is their limited capacity in terms of the total number of patients to be treated in a given time interval. Although the actual irradiation is rather quick, i.e. it typically lasts a few minutes (1- 2.5 minutes), a much longer treatment set-up normally precedes the irradiation. During such a set-up, the personnel positions the patient to be radiated as accurately as possible, typically based on a treatment plan, which has been developed or compiled earlier by the personnel based on diagnostic data, radiation beam data, etc. Such a treatment plan should include all relevant information for the actual radiation therapy treatment, such as the selected and optimized parameters from the treatment planning and the present set-up of the radiation therapy machine and its settings. After the positioning of the patient, but before the actual radiation therapy treatment, a treatment simulation is typically performed to test and verify the treatment plan. In the simulation procedure, the primary aim is setting up the equipment and patient according to the treatment plan. Often portal images, i.e. images based on the treatment beam itself, are used to verify the treatment and monitor its reproducibility. Furthermore, e.g. *in vivo* dosimetry or related techniques may be used to check the delivered radiation dose in the target volume and/or in adjacent tissues, preferably in organs at risk. If the measured data corresponds to the calculated data in the treatment plan, the actual radiation therapy treatment may be initiated.

As a consequence of the patient positioning and simulation procedure, the treatment set-up takes considerably longer time, generally at least 5 – 10

minutes and often more, than the actual irradiation. In addition, if some divergence between the measured and calculated data is detected during the simulation and the divergence exceeds the set-up margin, the treatment plan must be adjusted. This may in some cases simply be a correction of some parameters but also larger adjustments requiring a renewed treatment planning process with more anatomical information from a new diagnostic measurement. Either way, a new treatment plan is determined, which may be tested and verified in a renewed treatment simulation, which increases the time to treatment by several days.

Thus, the time, during which a radiation machine actually is employed for irradiating a patient, constitutes a small portion of the total time, during which the machine is occupied. This of course leads to poor utilization of the prior art radiation machines and that fewer patients can be treated during a given period of time.

A possible solution could be to perform the simulation procedure using a dedicated radiation simulation machine and not the actual radiation treatment machine. However, although the designs of the patient couches and the two machines used for the simulation and the treatment, respectively, are similar, it is almost impossible to correctly simulate the treatment using a different machine and possibly a different couch. This is due to problems with positioning the patient exactly in the same way on two different couches, even though the couches may have the same design. In addition, tissue and organs, including the target volume with a tumor, are deformable elastic structures and their positions relative to reference points used in the treatment plan are not rigid, but may change depending on e.g. posture of the patient, filling degree of bladder, respiratory motion, etc. Therefore, although the reference points may be aligned correctly during the treatment relative those during the simulation, the target volume may be misaligned.

Furthermore, the costly equipment in the treatment and simulator rooms will not be useful during most of the time of the patient set-up (often two to five times as long as the real simulation or treatment), reducing the cost effectiveness of the installations. In addition, many treatment set-ups are not made using the isocentric principle such as during electron and proton or light ion therapy, where generally a fixed distance between source and patient surface is used, making isocentric treatment units unnecessary.

SUMMARY

The present invention overcomes these and other drawbacks of the prior art arrangements.

It is a general object of the present invention to provide a radiation therapy machine with an excentric gantry.

It is another object of the invention to provide a radiation machine that can provide therapeutic radiation doses in several different treatments rooms arranged around the excentric gantry of the treatment machine.

Yet another object of the invention is to provide a radiation machine that can deliver the treatment with a clinical radiation beam to a patient in a first treatment room while simultaneously a simulator part of the radiation machine is used for treatment set-up and simulation for other patients in other treatment rooms as a preparatory process to the treatment.

It is a further object of the invention to provide radiation equipment with an excentric gantry design having integrated radiation treatment and simulator functionality and that can be used in multiple treatment rooms.

These and other objects are met by the invention.

Briefly, the present invention involves a radiation machine with an excentric gantry design that can be used for irradiating patients in multiple treatment

rooms. With such an gantry design it is possible to irradiate, e.g. deliver treatment radiation doses, to a first patient in a first treatment room while simultaneously performing treatment set-up and simulation procedure for at least a second patient in another treatment room using the same radiation treatment machine. As a consequence, the capacity of the radiation machine of the present invention in terms of the total number of patients to be treated during a given period of time is much larger compared to machines of the prior art.

The radiation machine is preferably arranged in the intersection of the walls and/or the ceiling/floor separating multiple treatment rooms. The radiation machine typically has a spherical or cylindrical design, allowing a radiation head to rotate in a dedicated spacing in the walls and/or ceiling/floor. As a consequence, the radiation head delivering the radiation doses can be turned between the different treatment rooms and therefore irradiate patients positioned in several different rooms.

In addition, each treatment rooms preferably comprise a simulator head with a light optical and/or diagnostic X-ray system being able to simulate the therapeutic beam from the radiation treatment head. These simulator heads could be arranged and move on a rail just outside of a rotary magnet and shielding of the radiation machine. Thus, in each room a low cost simulator could be used for patient set-up before the radiation head is turned into the treatment room for treatment operation. Alternatively, a few simulator heads could move between rooms and assist in setting up the patient prior to the treatment.

Very many different room configurations can be anticipated from the basic configuration of the radiation machine in the walls and/or ceiling/floor of the rooms. Depending on where a treatment room is located around the central excentric gantry, typically 30 - 60° oblique lateral anterior, posterior and/or straight vertical and/or horizontal beam directions are possible. It is even possible to use two excentric gantries in such configuration so that multiple

treatment portals can simultaneously be directed onto one and the same patient either as oblique lateral, parallel opposed or perpendicular beam combinations.

The excentric gantry of the radiation machine of the invention preferably comprises a beam scanning and bending system, such as a magnet based system, adapted for scanning and bending an incident radiation beam onto a patient in form of a narrow pencil beam. This scanning and bending system, or at least a portion thereof, is then rotated as the gantry and radiation head of the machine is turned between different rooms. A bending magnet of bending system could be laminated to allow fast field changes between accelerator pulses but could also be super conducting to minimize the bending radius of the magnet.

Due to the design of the bending and scanning system, the excentric gantry is well adapted for usage with light ions from protons and upwards to carbon and oxygen ions, including for example protons, deuterons, tritium and helium, lithium, beryllium, boron, carbon and oxygen ions.

The invention offers the following advantages:

- Can be efficiently used for irradiating several patients in different treatment rooms;
- Enables treatment set-up and simulation to be conducted in some rooms while the actual radiation treatment is simultaneously performed in another room;
- Increases the capacity in terms of the total number of patients that can be treated during a given period of time;
- Enables usage of light ion radiation with a compact gantry design and small bending magnet radius;
- Reduces the installation cost substantially since one low cost device with adjustable beam directions can advantageously be used in multiple treatment rooms instead of multiple expensive isocentric devices with fixed beam line configurations.

Other advantages offered by the present invention will be appreciated upon reading of the below description of the embodiments of the invention.

SHORT DESCRIPTION OF THE DRAWINGS

The invention together with further objects and advantages thereof, may best be understood by making reference to the following description taken together with the accompanying drawings, in which:

Fig. 1 schematically illustrates a prior art radiation therapy machine with an isocentric gantry design;

Fig. 2 schematically illustrates an embodiment of a radiation machine according to the present invention with an excentric gantry design surrounded by multiple treatment rooms;

Fig. 3 schematically illustrates the radiation machine of Fig. 2 irradiating a patient in another treatment room than in Fig. 2;

Fig. 4 schematically illustrates another embodiment of a radiation machine according to the present invention with an excentric gantry design with a different treatment room structure allowing vertical and horizontal beam delivering;

Fig. 5 schematically illustrates usage of two radiation machines according to the present invention with excentric gantry designs allowing two beams to be delivered simultaneously;

Fig. 6 is a cross section view of an embodiment of an excentric radiation machine according to the present invention;

Fig. 7 illustrates the radiation machine of Fig. 6 irradiating a patient in another treatment room than in Fig. 6; and

Fig. 8 is a cross section view of another embodiment of an excentric radiation machine according to the present invention reducing the gantry diameter.

DETAILED DESCRIPTION

Throughout the drawings, the same reference characters will be used for corresponding or similar elements.

The present invention relates to a radiation machine with an excentric gantry design that can be used for irradiating patients in multiple treatment rooms. With such a gantry design it is possible to irradiate, e.g. to deliver treatment radiation doses, to a first patient in a first treatment room while simultaneously allowing preparation for treatment or simulation or performing treatment set-up and simulation procedure for at least a second patient in another treatment room using the same radiation therapy machine.

As a consequence, the capacity, in terms of the total number of patients to be treated for a given period of time, of the radiation therapy and simulation machine of the invention is much larger compared to the prior art machines, e.g. the radiation machines of Fig. 1.

In the following the invention will be described with reference to a radiotherapy machine, delivering irradiation doses to a patient for the purpose of treatment, including curative radiation therapy, i.e. to eradicate a tumor, or palliative radiation therapy, where the aim is generally to improve quality of life of the patient by maintaining local tumor control, relieve a symptom or prevent or delay an impending symptom, and not primarily to eradicate the tumor. However, the radiation machine could alternatively be employed for other radiation purposes, such a single dose radio therapy or radio diagnostics.

Fig. 2 schematically illustrates a radiation machine of the invention with an excentric gantry 100 that is able to irradiate patients in four different

treatment rooms 61 to 64. Thus, the radiation machine is arranged in the intersection of the walls 72, 74 and the ceiling/floor 71, 73 separating the four rooms 61 to 64. The radiation machine typically has a spherical or cylindrical design, allowing a radiation head 120 to rotate in a dedicated spacing in the walls 72, 74 and ceiling/floor 71, 73.

In the figure, the gantry 100 is directed to irradiate 110 a target volume 55-1 in a first patient 50-1 positioned on a treatment couch 40-1 in a first treatment room 61. The radiation machine preferably also comprises a rotary radiation shielding and bending magnet (see Figs. 7-9) to deflect the radiation beam 110 into the currently used treatment room 61.

In addition, the treatment rooms preferably comprise simulator heads 200-2 to 220-4 with a light optical and/or X-ray system that is able to simulate the therapeutic beam 110. These simulator heads 200-2 to 200-4 could be arranged and move on a rail just outside of the rotary magnet shield. Thus, in the rooms 61 to 64 the low cost simulator 200-2 to 200-4 could be used for patient set-up before the radiation head 120 is turned into the treatment room for treatment operation. In the figure, three patients 50-2 to 50-4 are positioned on a respective treatment couch 40-2 to 40-4 and are currently subject to a treatment set-up and simulation procedure using the simulator heads 200-2 to 200-4 and simulator beams 210-2 to 210-4. In order to obtain maximum accuracy in the patient set-up (0.5-1 mm), a stereotactic treatment couch 40-1 to 40-4 is preferably used in the treatment rooms 61 to 64. Such a couch 40-1 to 40-4 is then automatically positioned and individually adjusted to each patient. Note that in the present invention one and the same couch 40-1 to 40-4 can be used both for the patient set-up procedure and the treatment and diagnostic imaging activities.

It could be possible that the treatment rooms 61 to 64 are equipped with one simulator head 200-2 to 200-4 each. Alternatively, two or more rooms 61 and 62 could share a single common simulator 200-2. In such a way, the

simulator 200-2 is able to move, e.g. by means of a rail system, in a dedicated gap 80 in the floor/ceiling 71 (or wall) separating the rooms 61 and 62.

Once, the first patient 50-1 is treated and the set-up and simulation procedures are finished in another room, the gantry 100 may be turned so that the radiation head 120 now can deliver irradiation doses to another patient in another treatment rooms. This scenario is illustrated in Fig. 3, where the gantry has been rotated to irradiate a target volume 55-2 of a second patient 50-2. In the room 62 where the patient 50-2 currently is being irradiated using the treatment beam 110, the simulator head 200-2 in that room 62 is moved, using the rail system, away either to one side of the room 62, in order to allow the radiation head 120 to irradiate the patient 50-2, or to the treatment room 61, for usage therein in treatment simulation. In the first room 61, a new patient 50-1 may be positioned on the couch 40-1 and a set-up procedure and simulator using a simulator head 200-2 can be performed.

Generally, the sequence of events taking place in a given treatment room is as follows. Firstly, the equipment (couch and radiation and positioning equipment) in the room is readjusted in order to prepare for a next patient to be treated. A patient set-up is then conducted where the patient is accurately positioned on a couch, preferably a stereotactic couch, using different patient positioning systems, e.g. laser-based positioning systems, such as a patient positioning system described by Andres Brahme et al in the International Patent Application No. PCT/SE03/00964. Once the patient is accurately positioned on the (stereotactic) couch, a treatment simulation is then performed. During this simulation a light optical and/or diagnostic X-ray system in a simulator head of the excentric gantry of the invention is used. Thereafter the actual treatment can be performed.

Since the treatment set-up normally can take at least 5 to 10 minutes and the actual treatment of the patient is much quicker, about 1-2.5 minutes, the treatment rooms 61 to 64 and patients 50-1 to 50-4 will generally have access to the therapeutic beam about every 10 minutes. For the gantry design of Figs.

2 and 3 this implies that up to $6 \times 4 = 24$ patients can be treated per hour in a very busy therapy center, and still allowing ample set-up time and patient care in each treatment room 61 to 64. This should be compared to the corresponding capacity of a prior art (isocentric) radiation machine, which typically maximally can treat up to 4 to 6 patients during that one hour time period.

Very many different room configurations can be anticipated from the basic four rooms configuration illustrated in Figs. 2 and 3. Depending on which quadrant a treatment room is located around the central excentric gantry, typically 30 - 60° oblique lateral anterior (room 61 and 64) or posterior (room 62 and 63) beam directions are possible. With light ions it is also very convenient to treat a patient requiring 2-4 beam portal directions in his treatment plan by one beam portal per day and thus sequentially use the different treatment rooms of Figs. 2 and 3 as required by the beam directions.

It is also possible to have straight vertical and/or horizontal treatment beams in some rooms at the same time as other rooms use obliquely incident beams. Fig. 4 schematically illustrates this situation with three different treatment rooms 61 to 63 having access to one common radiation machine with excentric gantry design according to the invention. Due to the position of the gantry in the ceiling 71 relative a patient 50-1 on a couch 40-1 in room 61, straight vertical treatment beams 110 are possible. However, for a patient 50-3 in another treatment room 63 the beams will obliquely incident into the his target volume 55-3. Correspondingly, if the radiation machine and the gantry 100 basically are arranged in a wall 72 between treatment rooms 62 and 63, a patient 50-2 may be vertically irradiated. It is anticipated by the invention that an excentric gantry and radiation therapy machine of the present invention could be adapted for only radiating horizontally and possibly obliquely or only vertically and possibly obliquely.

It is also possible to combine vertical, anterior and posterior beams in an excentric gantry with six surrounding treatment rooms by combining the

solutions from Figs. 2 or 3 and 4. Such a gantry design results in both oblique lateral anterior and posterior beams in four treatment rooms as well ass parallel opposed vertical beams in two rooms.

With reference to Fig. 5, it is even possible to use two excentric gantries 100-1 and 100-2 in such configuration that multiple treatment portals can simultaneously be directed onto one and the same patient 50-4 either as oblique lateral (as in the figure), parallel opposed and/or perpendicular beam combinations 110-1 and 110-2. Thus, in the configuration of Fig. 5, patients 50-3 and 50-4 in room 63 and 64 can be irradiated with beams 110-1 and 110-2 from the radiation heads 120-1 and 120-2 of the two excentric gantries 100-1 and 100-2. In the figure, the remaining four rooms 61, 62, 65 and 66 only have access to one of the gantries 100-1 or 100-2. It is anticipated by the invention that more than two excentric gantries according to the present invention may be arranged in a common configuration so that at least two or more gantries are able to irradiate a patient in one of the treatment rooms. It is also possible, by changing the arrangement of the gantries in the walls and ceiling/floor, to combine the gantry arrangement of Figs 2 and 3 with the arrangement in Fig 4.

Fig. 6 illustrates a perpendicular cross section view of an embodiment of an excentric gantry design of the invention. The incident radiation beam may come from a nearby located radiation source, such as a radiation source arranged in a room next to the radiation machine and using bending magnets to direct the radiation into the machine. It is also possible to use a radiation source that is arranged directly on the radiation machine, or a relatively far-placed radiation source, e.g. synchrotron, that can deliver the required radiation to several different treatment units and excentric gantries.

Herebelow the invention will be described with reference to a radiotherapy machine comprising a (pencil) beam scanning system for irradiating a patient. However, the invention is not limited to such radiotherapy machines.

According to a preferred embodiment of the invention, the incident radiation beam first enters quadrupoles 102 for focusing the beam. Thereafter, the beam preferably enters a scanning magnet 104. This magnet 104 deflects the beam and gives it a scanning motion in the plane of the drawing. The beam emerges from the scanning magnet 104 as if it came from an effective scanning center typically near the middle of the magnet 104. The beam scanning in the plane of the drawing is then bent or deflected in a bending or deflecting magnet 106 for directing the incident beam down to the radiation head 120 and subsequently into the target volume 55 of a patient 40. The bending magnet 106 could be laminated to allow fast field changes between accelerator pulses but also super conducting to minimize the bending radius.

Due to the beam bending functionality of the bending magnet 106, the beam enters the radiation head 120 and a second scanning magnet 122. This magnet 122 has the ability to scan or deflect the beam in a plane transversal to the plane of the drawing, i.e. in and out of the plane of the drawing. The beam could then enter a collimator 124 that is arranged to prevent radiation outside the intended scanning beam to continue down to the patient 50. An optional transmission monitor could be provided below the collimator 124 for registering the amount radiation passing from the collimator 124.

The scanning system of Fig. 6 could also be switched off to use a regular dual or single scattering foil system in order to get simple uniform beams.

Before the radiation beam 110 leaves the radiation head 120 it preferably passes a second collimator 126. This collimator 126 is preferably of a multi-leaf collimator type. Such a multi-leaf collimator type comprises a plurality of pairs of opposed elongated, curved or flat, in cross-section wedge shaped leaves, each adjacent leave arranged side by side and such that a fan-shaped configuration which converges towards an apex of the effective radiation source 125. Contrary to the present invention with preferably a single source 125 conventional scanning systems with two consecutive dipole scanning magnets will have different effective source locations in the two scanning

planes. The leaves of the collimator 126 are mounted for (combined) rotational and/or translational movement. This dynamic multi-leaf collimator 126 can be used to protect normal tissues lateral to the tumor, i.e. the target volume 55, at the same time as the magnetic field of the bending magnet 106 is rapidly adjusted to the energy required at each scan position. Normally, the energy remains fixed during the scanning of the beam 110 at a certain depth in the patient 40.

The scanned beam 110 typically covers a 30 cm × 30 cm field size on the patient 40. If a transmission monitor is provided in the radiation head 120, this monitor could continuously follow and interlock the motion of the scanned beam.

The radiation machine of the invention with an excentric gantry design as illustrated in Fig. 6 is well adapted for usage of a radiation beam of light ions, i.e. from protons and upwards. As is well known in the art, light ions require very large bending radii (up to several meters). Prior art radiation machines providing light ion dose delivery suffer from high installation cost. In addition, such prior art machines have several large sized bending magnets and their pool gaps, which are required to scan the beam in both planes before the bend and get a gantry adapted for delivering ion beams in arbitrary orientations in the treatment room. However, the bending magnet 106 used in the present invention can have a small gap and smaller radius and consequently smaller overall size than the prior art used magnets. This results in a compact pencil beam scanning system comprising the scanning and bending magnets 104; 106; 122 that can provide (30 cm × 30 cm) beams to several treatments rooms placed around the excentric gantry 100.

Although the gantry design is suitable for usage with light ion radiation it can also be used for any charged particle or even neutral particles like neutrons and photons by first scanning the primary deflected proton or deuteron and electron beams to generate scanned neutral beams, see US Patent No. 4,442,352, which is hereby incorporated by reference.

Furthermore, it is possible to have a rotating beam, which is deflected by the bending magnet less than 90 ° in order to save power and to get oblique beams in multiple treatment rooms. Angles as low as 30 ° up to some 60 ° could be useful in special cases.

Although the rotation axes of the excentric gantries illustrated in Figs. 2 to 6 are horizontal, the present invention is not limited thereto. The rotation axis can have any angle from vertical to horizontal, somewhat dependent on how the beam is extracted from the accelerator and the range of variability needed clinically.

When the radiation machine is to be used for treating a patient in another treatment room, the gantry 100 is simply turned, thus resulting in a rotation of the scanning and bending system and the radiation head 120. Fig. 7 illustrates this principle, where the excentric gantry 100 of the radiation machine of Fig. 6 is turned from irradiating a patient in a first treatment room 61 to irradiating a second patient 50 lying on a treatment couch 40 arranged in a second treatment room 62. As is seen in the figure, due to the rotation of the gantry 100, the bending magnet 106 now directs the incident beam towards this second treatment room 62. In this way the single scanning, collimation, beam bending and angular adjusting system can be used in several treatment rooms and significantly reduces the cost for the installation.

Fig. 8 illustrates another possible design of the internal units of the beam scanning and bending system of the excentric gantry 100 of the present invention. This embodiment minimizes the diameter of the rotary gantry including the magnet 106 and treatment head 120. Similarly to the embodiment illustrated in Figs. 6 and 7, the incident (light ion) radiation beam, preferably, first enters quadupoles 102. The beam then enters a bending and scanning magnet 104 that scans the beam in the plane of the drawing. The scanned beam is then bent in a (super conducting) bending magnet 106. The bending magnet 106 preferably directs the beam into a

second scanning magnet 122. This scanning magnet 122 and the collimators 124 and 126, where discussed in connection with Fig. 6.

It will be understood by a person skilled in the art that various modifications and changes may be made to the present invention without departure from the scope thereof.

ABSTRACT

The present invention refers to a radiation machine comprising an excentric gantry 100 that is arranged for being able to provide irradiation to several patients (40-1 to 40-6) positioned in different treatment rooms (61 to 66) around the radiation machine. A simulator head (200-1 to 200-6) is preferably arranged together with the radiation machine so it can be used in each respective treatment room (61 to 66). In such a case, while a first patient (40-1) is being treated in a first room (61), a treatment set-up procedure, including correct positioning of patients (40-2 to 40-4) and simulation of the treatment, can simultaneously take place for other patients (40-2 to 40-4) in the other treatment rooms (62 to 64). As a result, the capacity in terms of the total number of patients to be treated for a given time length is much larger for the excentric radiation machine of the invention compared to prior art (isocentric) machines.

(Fig. 2)

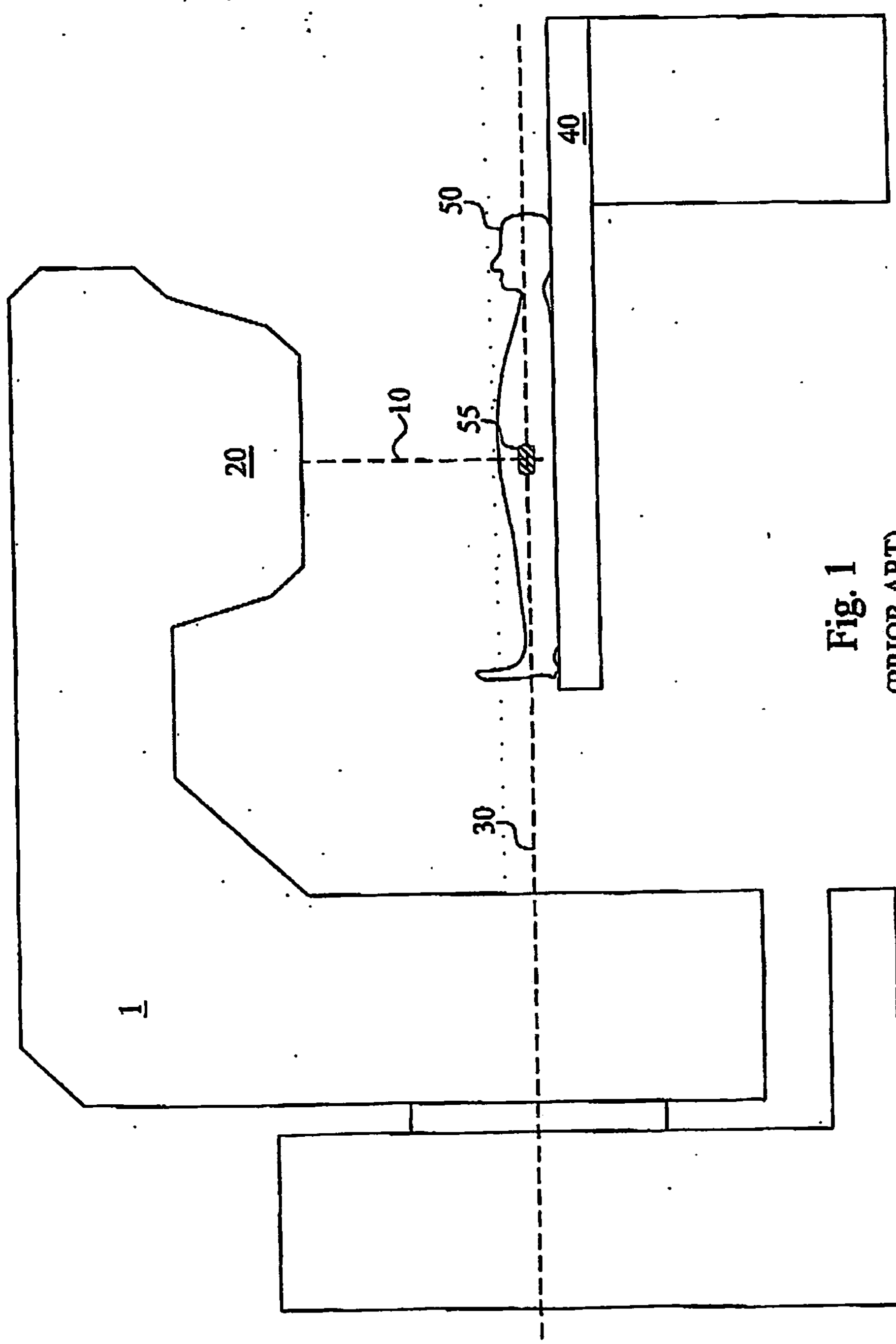

Fig. 1
(PRIOR ART)

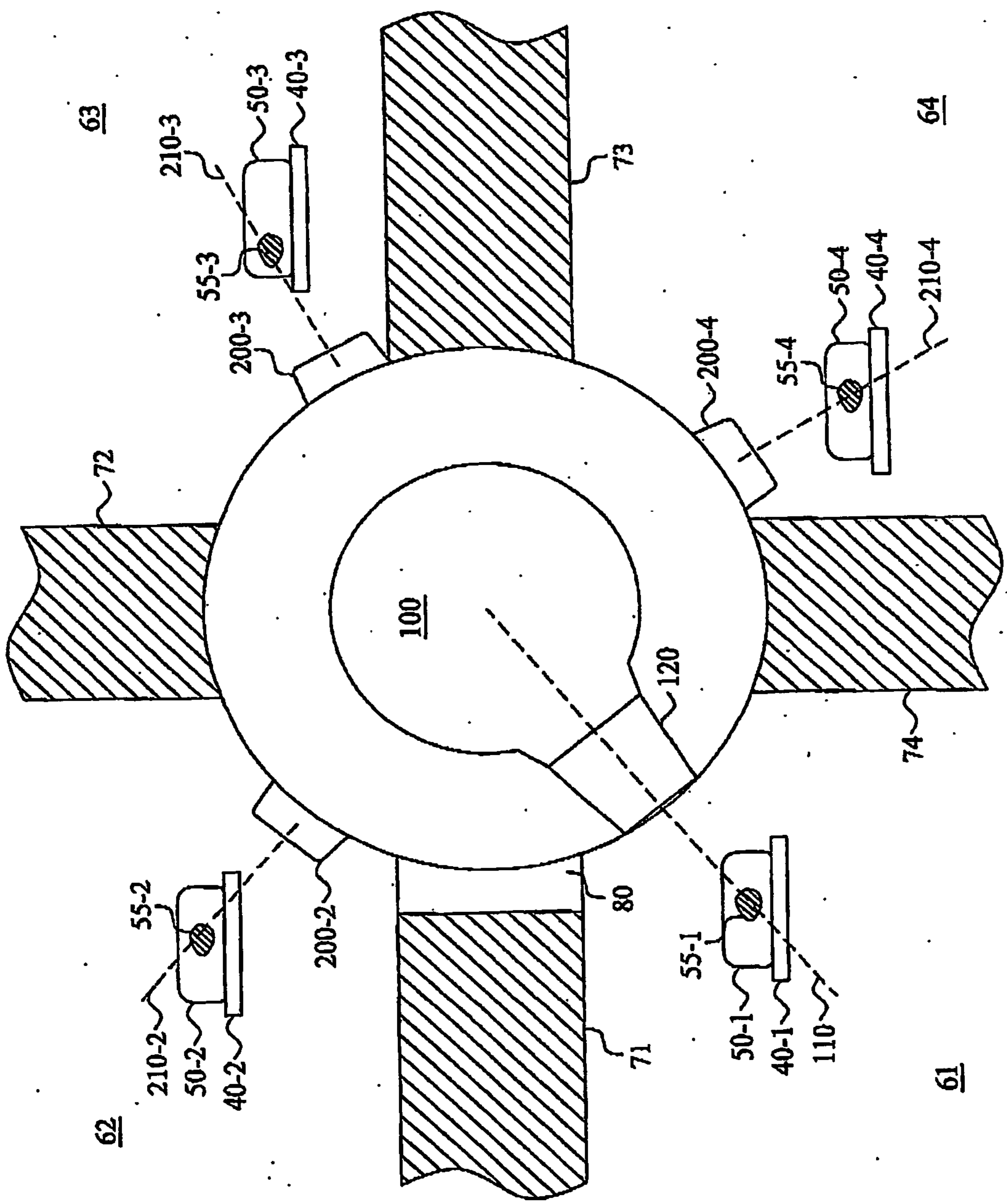

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Fig. 2

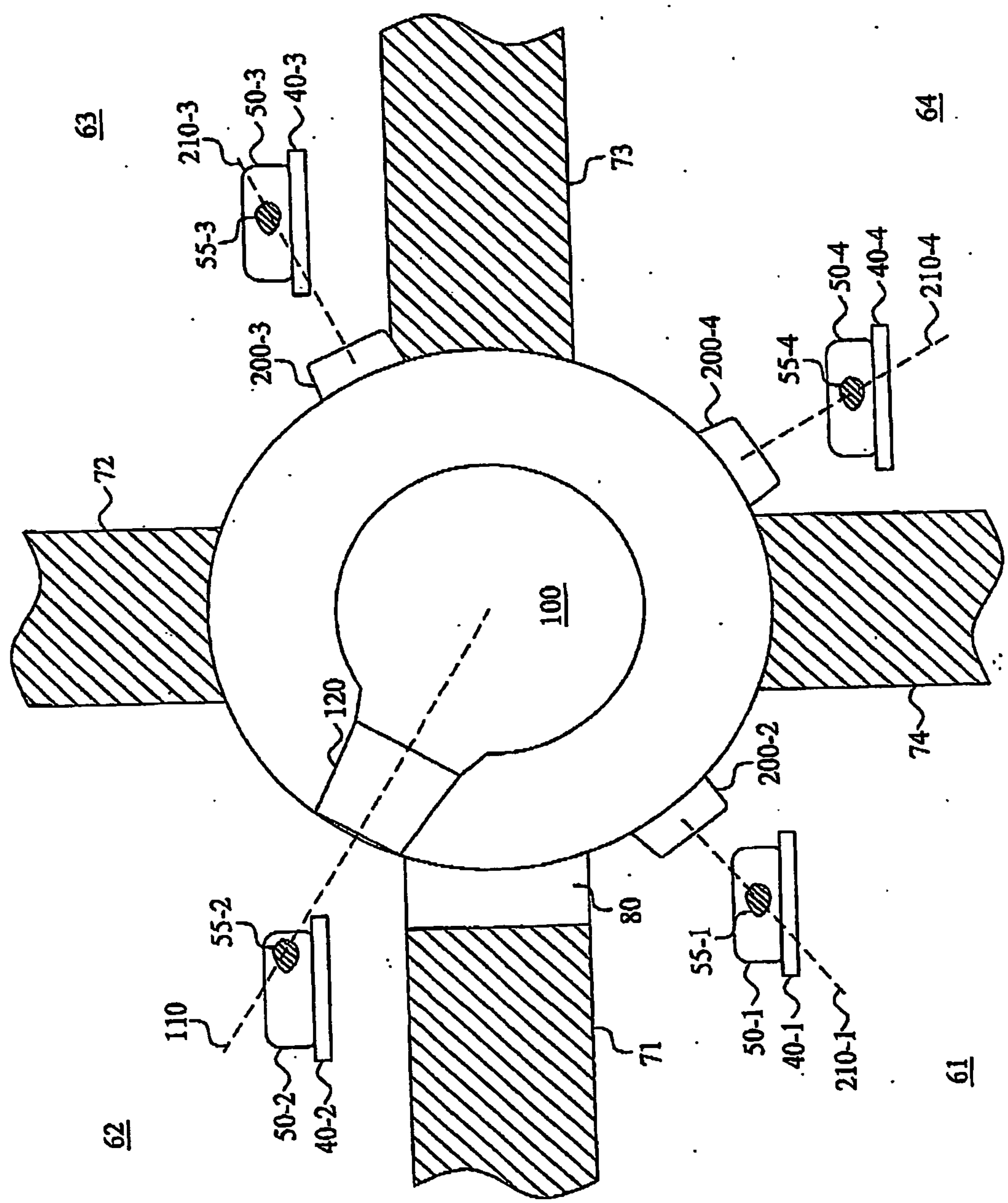
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Fig. 3

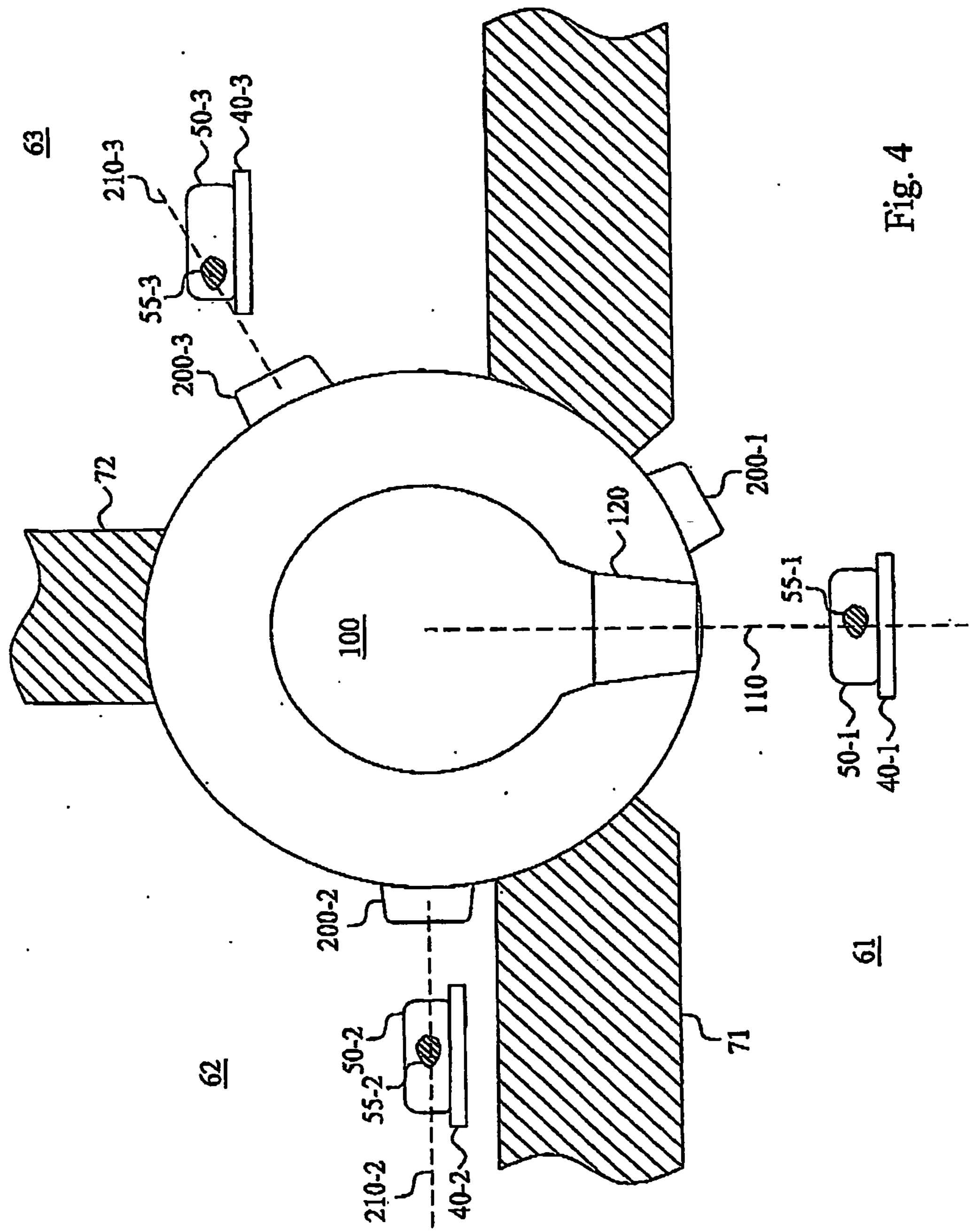
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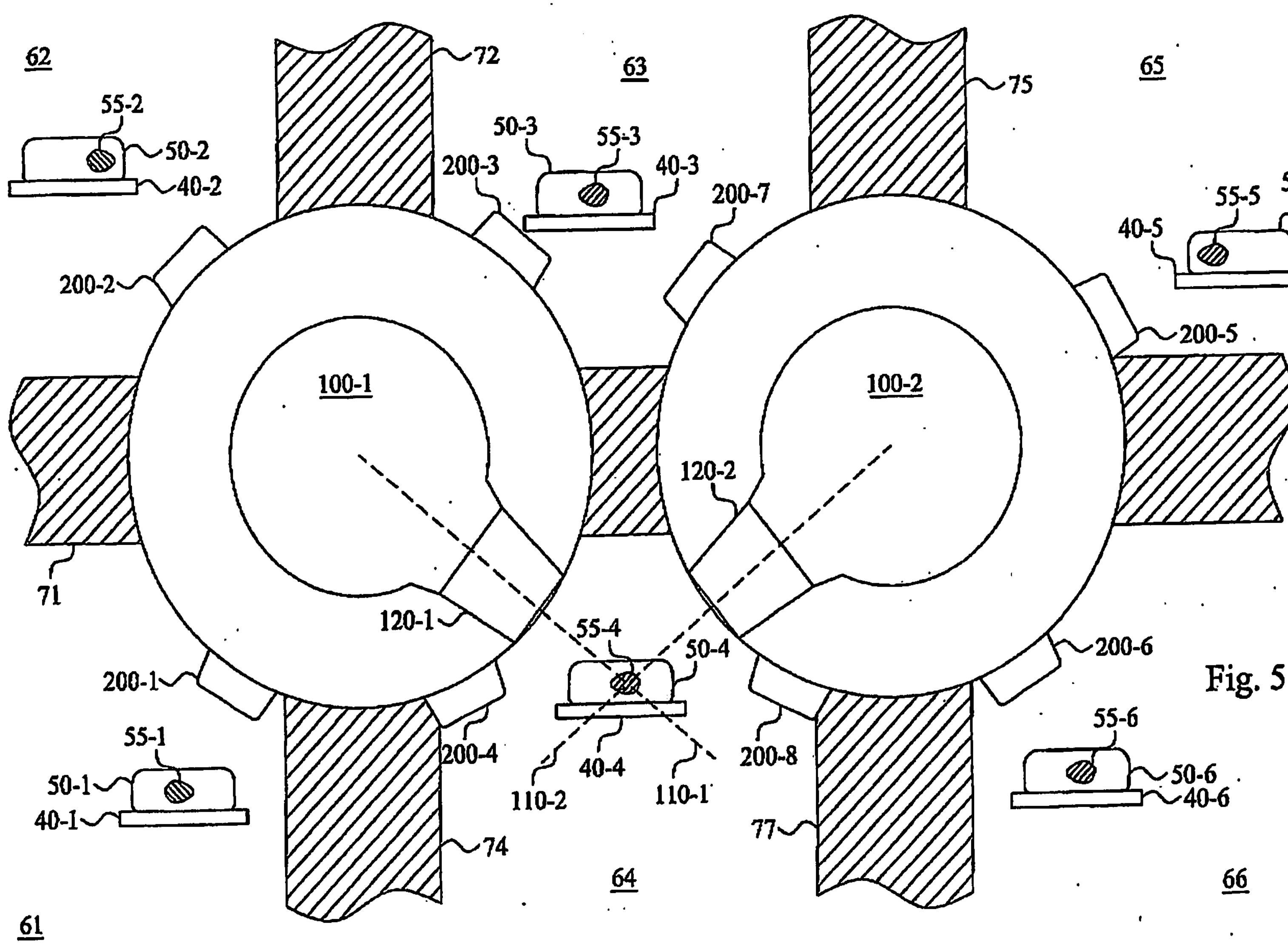
Fig. 4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61

Fig. 5

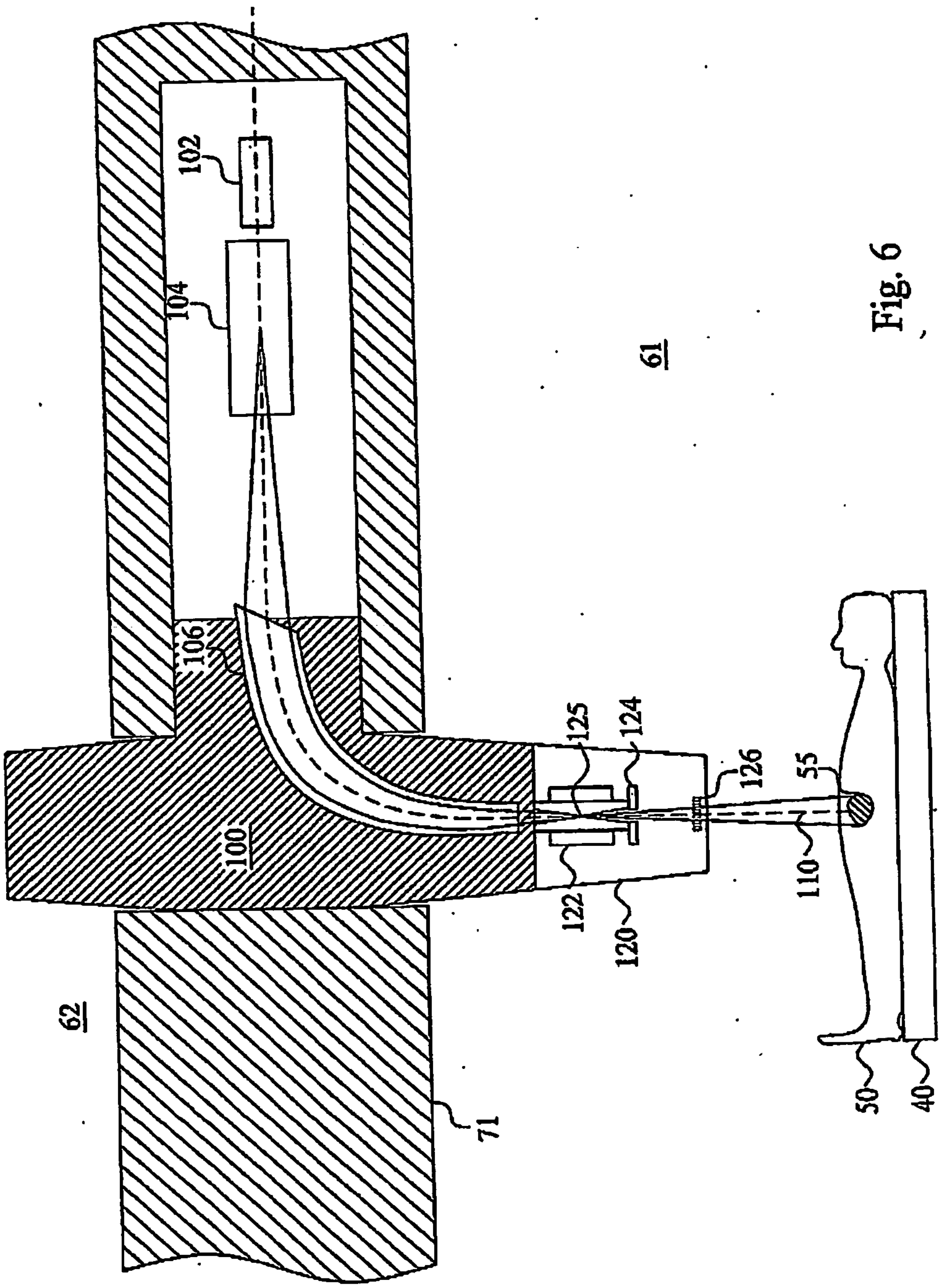

Fig. 6

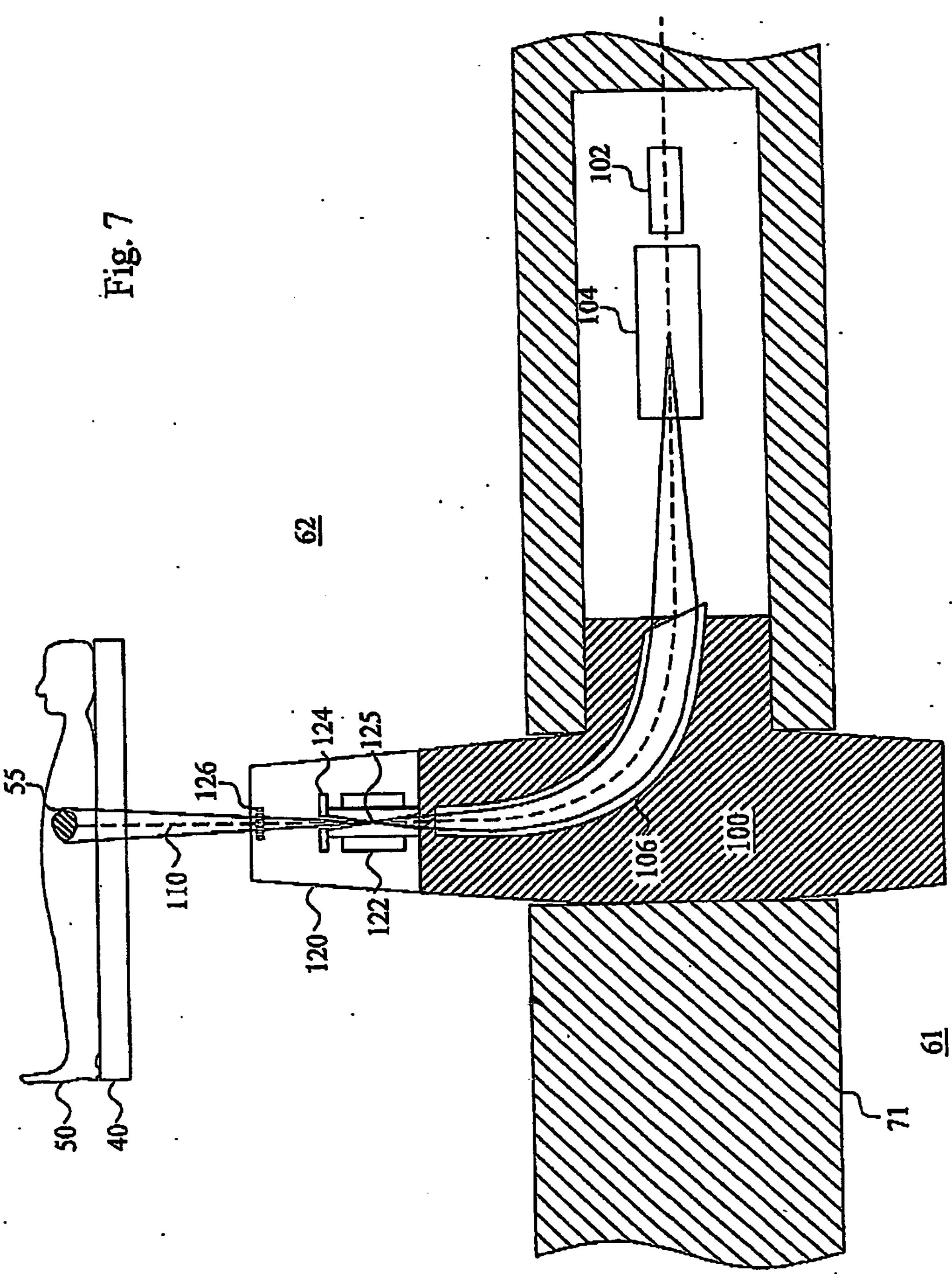

Fig. 7

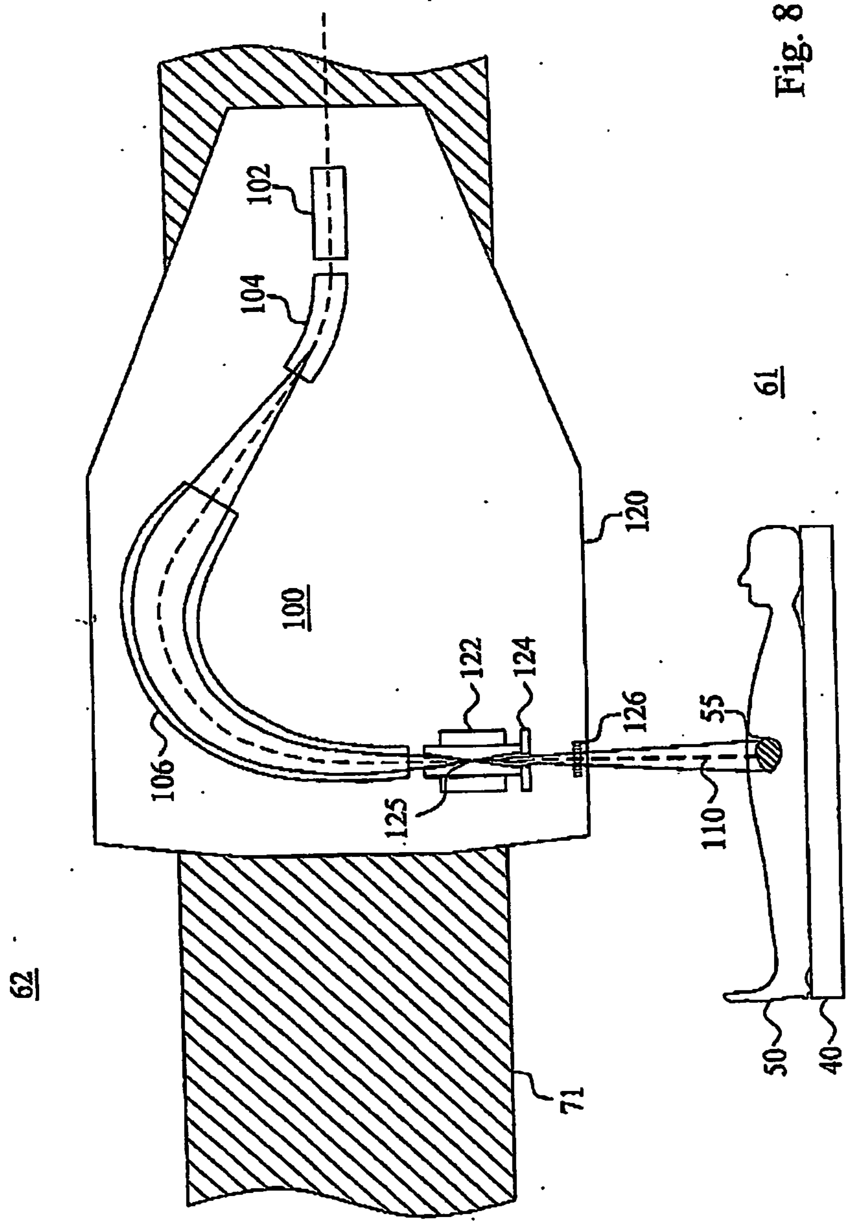

Fig. 8

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